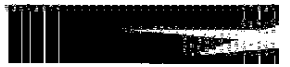


F.0 IPT
HLA Testbed

Russ Richardson

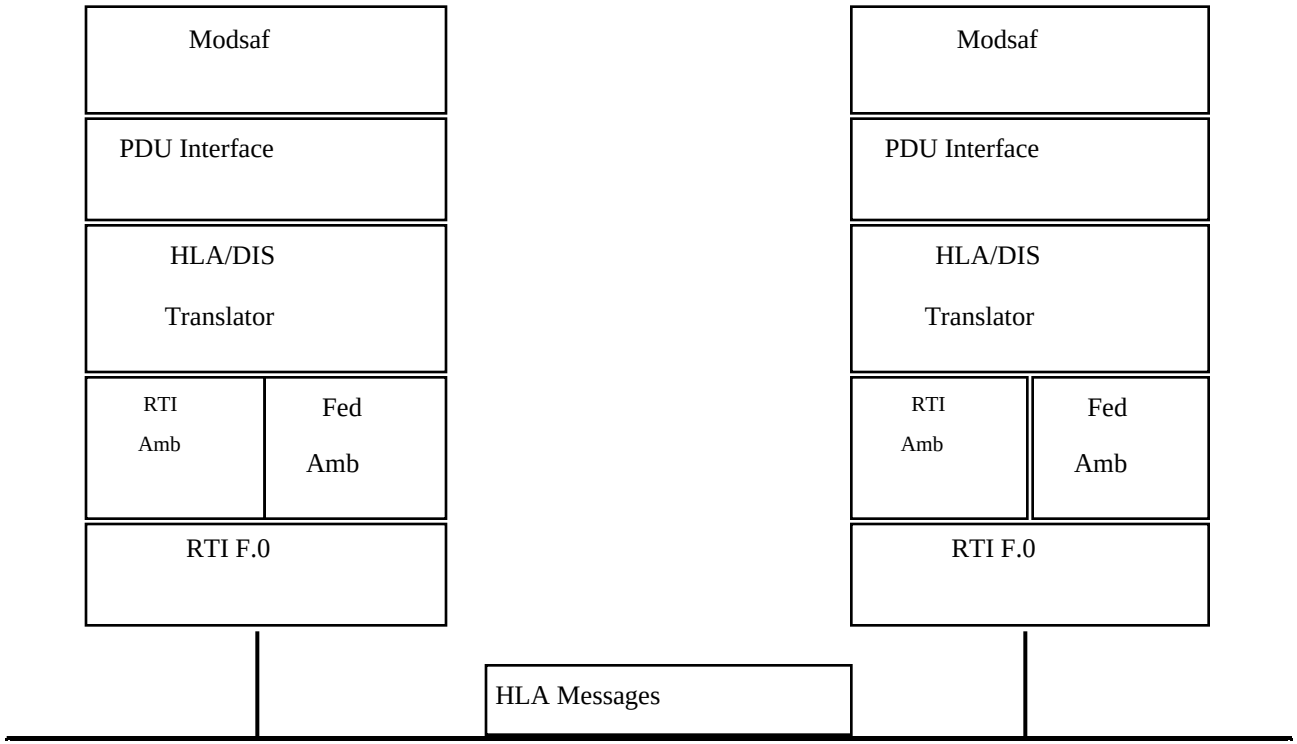
Dec 18, 1996

Test Bed Testing

- Testing Of F.O
  - Structured test of services using 4 applications
    - JAGER
      - scale , federates, objects, updates/sec typical app
    - Hello World
      - high number of federates with low obects but large updates/sec 1700
    - Eagle
      - time management services very low update rate, large #objects
    - ModSAF
      - best effort message loss
  - Code walk through and verification test of components
  - Typical Performance results
  - Products
    - Feedback to IPT in the form of Bug reports and performance numbers

Eagle and ModSAF Test Scenarios

- 4 Red Tanks in Defense Vs 4 Blue Tanks + 1 Fighter in attack--Divided among 2 and 4 federates
- 8 red tanks 2 anti-air craft vehicles in road march Vs 4 rotary wing AC + 1 Wide area viewer in attack - 4 federates
- 54 red tanks in defense Vs 54 tanks + 4 rotary wing AC + 1 wide area viewer- 4 and 8 federates
- Status--ModSAF scenarios built using Korean terrain, Eagle scenarios on korean terrain completed by Oct 16th


Modsaf
PDU Interface
HLA/DIS
Translator
RTI
Amb
Fed
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RTI F.0
Modsaf
PDU Interface
HLA/DIS
Translator
RTI
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Fed
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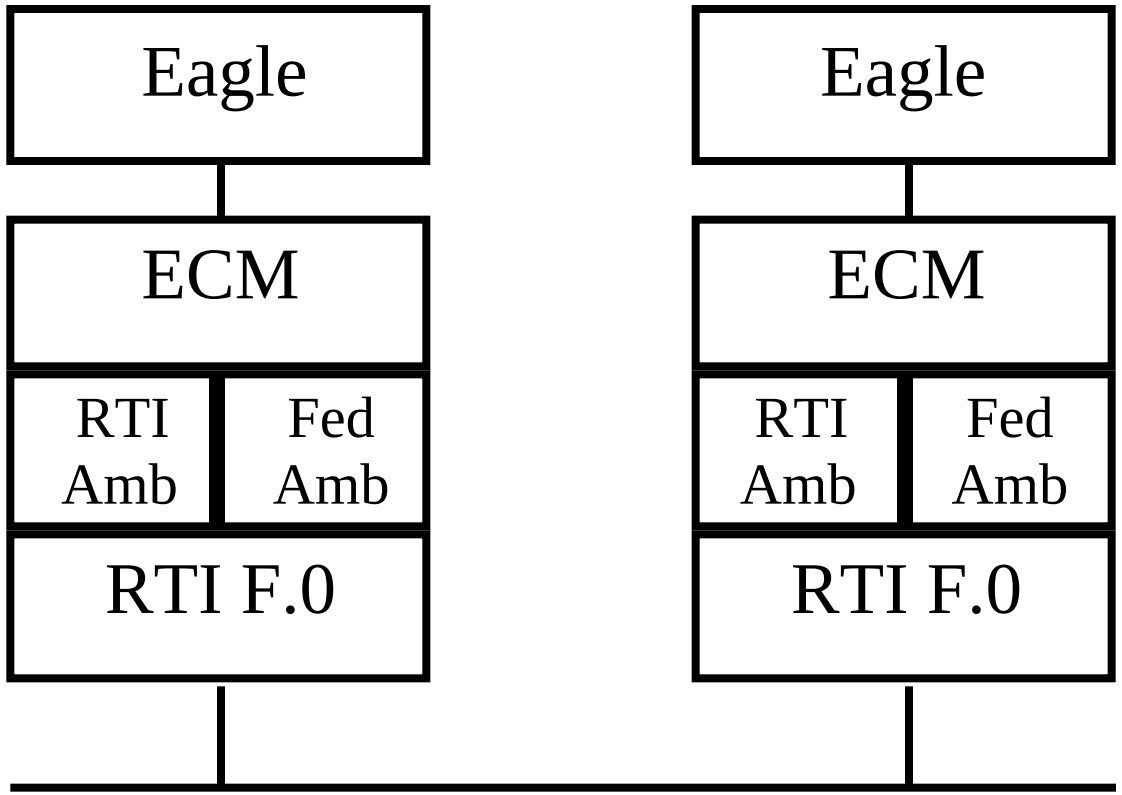
RTI F.0
HLA Messages


Eagle
ECM
RTI Amb
Fed Amb
RTI F.0
Eagle
ECM
RTI Amb
Fed Amb
RTI F.0

Federation Management Services Tested By Application

Test No.	Service Tested	ModSAF	Distrib. Eagle	Hello World	Jager
1	Create Federation Execution	.	.	.	.
2	Destroy Federation Execution	.	.	.	.
3	Join Federation Execution	.	.	.	.
4	Resign Federation Execution	.	.	.	.
5	Request Pause	NA	NA	NA	NA
6	Initiate Pause	NA	NA	NA	NA
7	Pause Achieved	NA	NA	NA	NA
8	Request Resume	NA	NA	NA	NA
9	Initiate Resume	NA	NA	NA	NA
10	Resume Achieved	NA	NA	NA	NA
11	Request Federation Save	N/A	N/A	N/A	N/A
12	Initiate Federate Save	N/A	N/A	N/A	N/A
13	Federate Save Begun	N/A	N/A	N/A	N/A
14	Federate Save Achieved	N/A	N/A	N/A	N/A
15	Request Restore	N/A	N/A	N/A	N/A
16	Initiate Restore	N/A	N/A	N/A	N/A
17	Restore Achieved	N/A	N/A	N/A	N/A

Object Management Services Tested By Application

Test No.	Service Tested	ModSAF	Distrib. Eagle	HW	JAGER
1	Request ID	.	.	1	1
2	Register Object	.	.	1	1
3	Update Attribute Values	.	.	1	1
4	Discover Object	.	.	1	1
5	Reflect Attribute Values	.	.	1	1
6	Send Interaction	.	.	1	1
7	Receive Interaction	.	.	1	1
8	Delete Object				
9	Remove Object				
10	Change Attribute Transportation Type				
11	Change Attribute Order Type				
12	Change Interaction Transportation Type				
13	Change Interaction Order Type				

Declaration Management Services

Test No.	Service Tested	ModSAF	Distrib. Eagle	Hello World	Jager
1	Publish Object Class	.	.	.	.
2	Publish Interaction Class	.	.	.	.
3	Subscribe Object Class Attribute	.	.	.	.
4	Subscribe Interaction Class	.	.	.	.
5	Control Updates	.	.	.	
6	Control Interactions	.	.	.	

Section	Service Title	ModSAF	Dist. Eagle	Hello World	Jager
5.1	Request Attribute Ownership Divestiture				
5.2	Request Attribute Ownership Assumption †				
5.3	Attribute Ownership Divestiture Notification †				
5.4	Attribute Ownership Acquisition Notification †				
5.5	Request Attribute Ownership Acquisition				
5.6	Request Attribute Ownership Release †				
5.7	Query Attribute Ownership				

Time Management

Section	Service Title	ModSAF	Dist. Eagle	Hello World	Jager
6.1	Request Federation Time				
6.2	Request LBTS				
6.3	Request Federate Time		*		
6.4	Request Minimum Next Event Time				
6.5	Set Lookahead		*		
6.6	Request Lookahead				
6.7	Time Advance Request	*	*	*	*
6.8	Next Event Request		*		
6.9	Flush Queue Request				
6.10	Time Advance Grant †	*	*	*	*

Typical Performance Results

Test	Application	Mean Federate Updates/Sec	Mean # Attributes/update	# Federates	# objects
1	Jager	140	6	6	60
2	ModSAF	35	21	4	120
3	Eagle	.2	27	4	573
4	HW	104	1	8	8
5	HW	154	1	4	4
6	HW	193	1	2	2

We are learning how to quantify the RTI Performance

Test Configuration

- Solaris 2.5
- Sparcworks Compiler
- Sun Sparc 20 and Ultra 2
- Ethernet Router (Bay Network) and ATM switch running IP multicast (Fore)
- Instrument through Measure of Performance (MOP) Wrapper class
  - Every RTI and Federate Ambassador message sent via MOP manager class

Test Bed Testing (cont...)

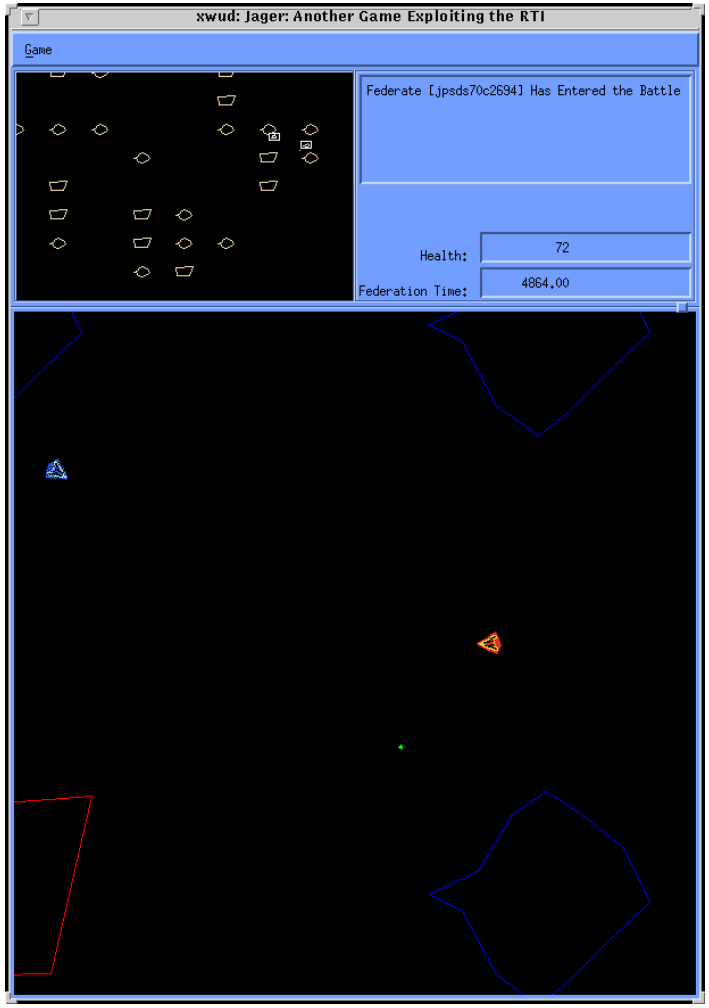
- Post Release Testing (Jan 97)
- Concentrate on RTI extension
- Interoperability testing between federates on different platforms

JAGER

- Multiuser distributed game to exercise/demonstrate RTI services
- Development
  - OOA/D
  - Will exercises all F.0 Supported services - initial release will exercise all services except ownership management
- Tutorial
  - Interactive WWW tutorial (including FEDEP products, design docs, and walkthrough of using RTI)
  - Tutorial flow is based on the FEDEP model
    - FedEx Sponsor -> Objectives -> Scenario Dev. & Conceptual Analysis -> Federation Design -> Fed. Development -> HLA FOM

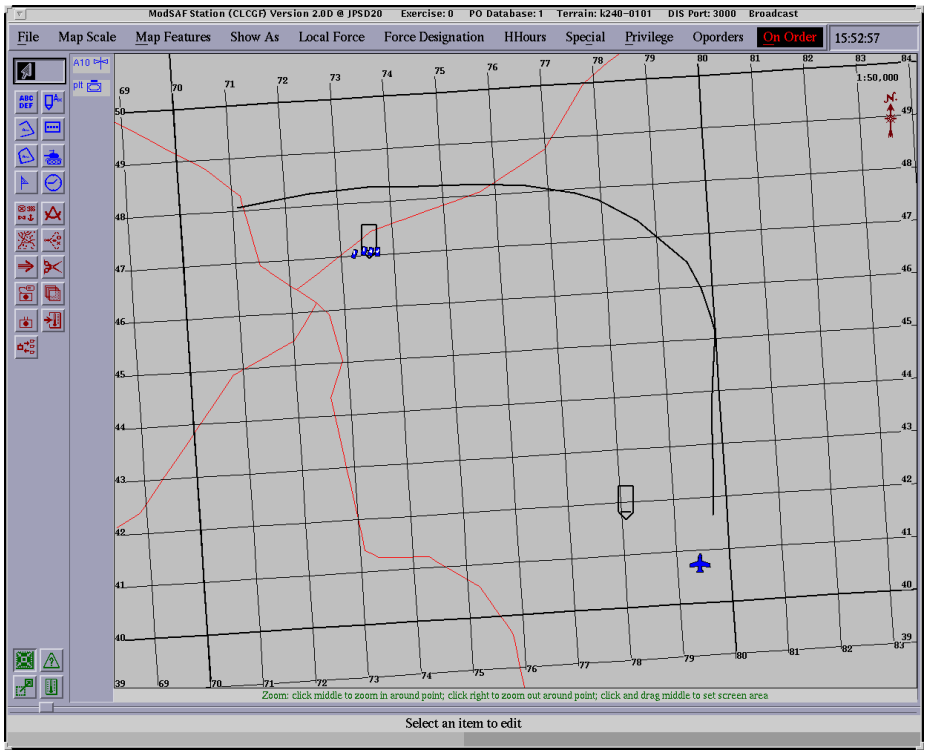
JAGER Federate

- Interactive game allows at least 10 players
- Exercise RTI to assure correct Installation
- Easy and Fun example utilizing all HLA RTI services



ModSAF Federate

- Widely Used Entity Based Simulation.
- Used to Test and Demonstrate RTI.
- Presently Using Version 2.0D, working on 2.1.
- Exercises all F.0 supported services but Ownership Management

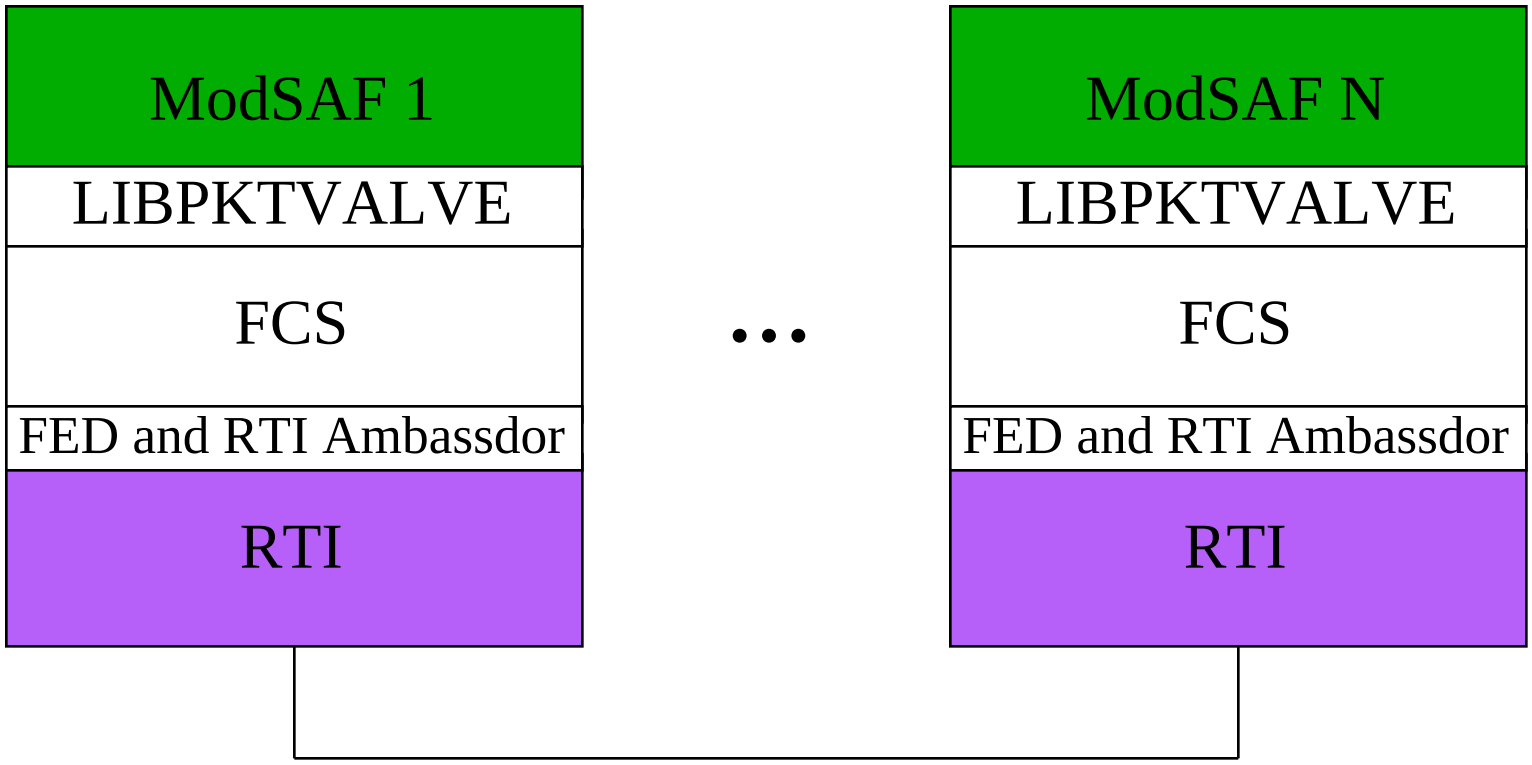


Scenarios for HLA ModSAF

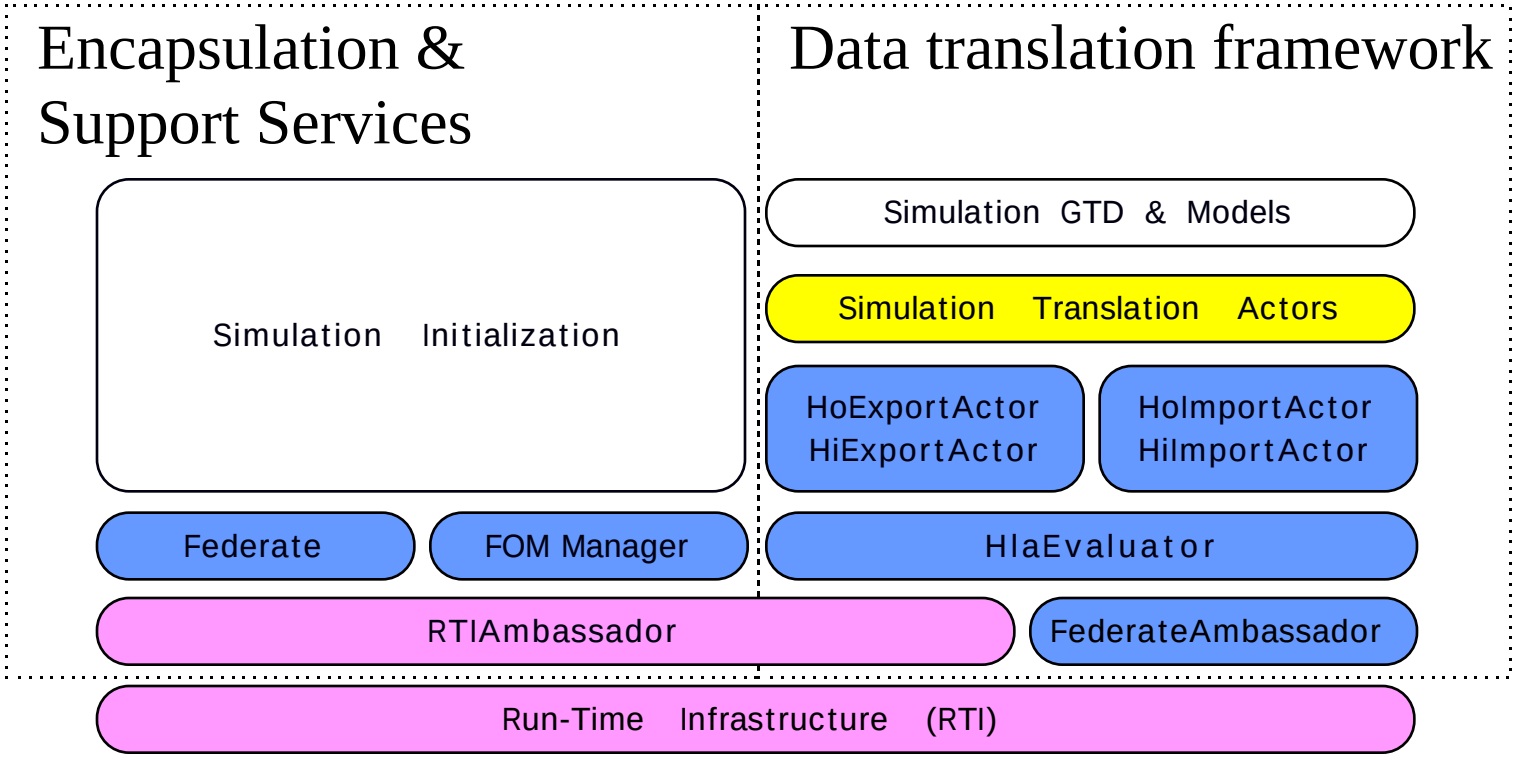
- Korean Terrain / Data base.
- Runs in Real Time using reliable data trasnsport with recieve ordering.
- 1>>> 4 Red Tanks (T80s) in Defense Vs 4 Blue Tanks (M1s)+ 1 Fighter (A10) in attack--Divided among 2 federates (blue and red).
- 2>>> 8 red tanks (T80s) 2 anti-air craft vehicles (ZSU23-4m) in road march Vs 5 rotary wing AC (AH64D) + 1 fighter in attack (A10) over 2 and/or 4 federates.
- 3>>> 54 red tanks (T80s) in defense Vs 54 blue tanks (M1s) + 5 rotary wing AC (A64D)+ 1 wide area viewer (JSTARS) over 2 and/or 4 federates.

HLA ModSAF Architecture

- Each ModSAF Federate is an Executable

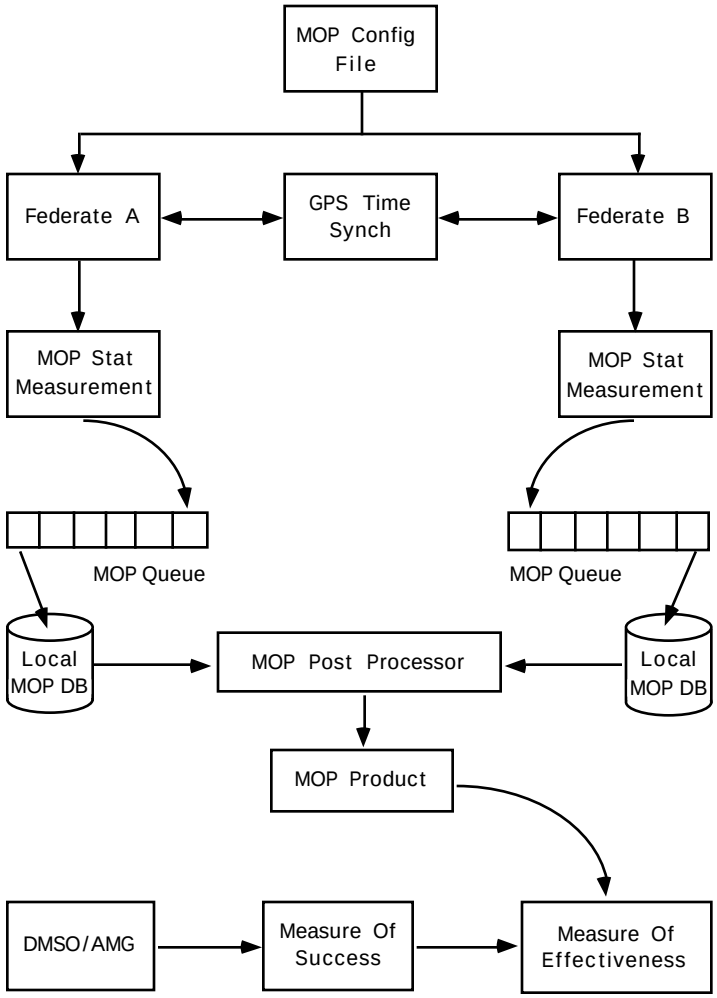


Federation Common Software



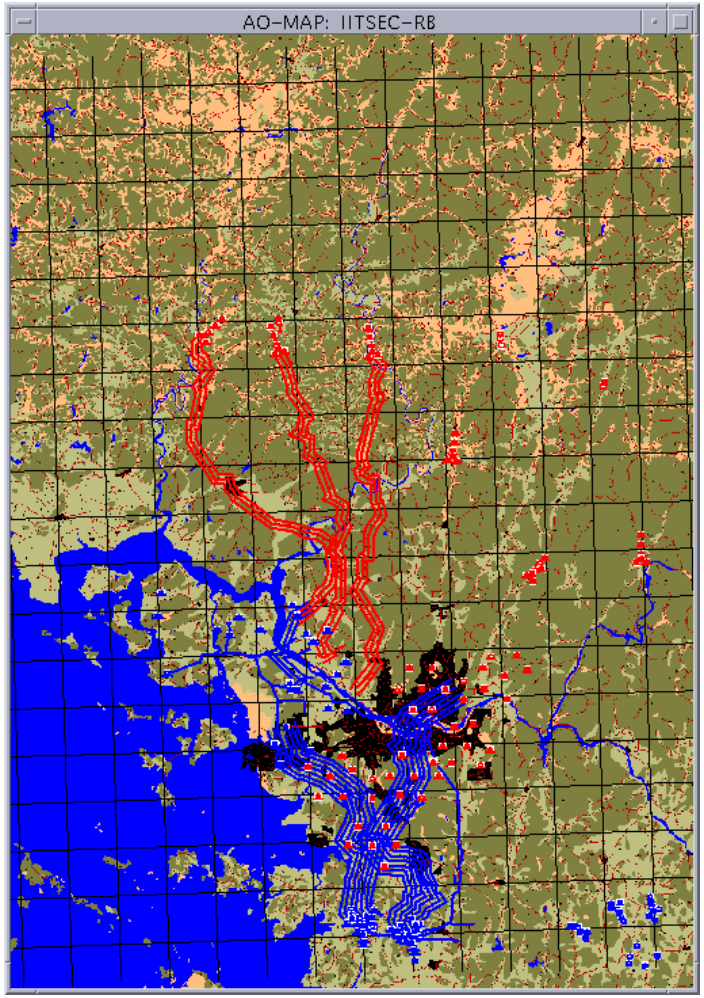
RTI Performance Instrumentation

- Instrumentation Approach
  - Goal: Measure & collect with as little intrusion as possible
  - Log relevant RTI invocations for latency post-processing
  - Use separate thread for I/O to local DB to reduce intrusion
- Instrumentation Plan
  - Specifies required information for instrumentation of Performance Framework including Latency, Resource Utilization, Configuration & Control variables
- MOP extension
  - Wrap RTIambassador and FederateAmbassador interfaces
  - Add persistence of MOP data
  - Add support for compile & run-time selection of MOP's to collect



Eagle Federate

- US Army TRAC developed Simulation for Analysis.
- Used to Test and Demonstrate RTI.
- Time managed aggregate level simulation.
- Exercises all F.0 supported services.



Eagle Demonstration Summary

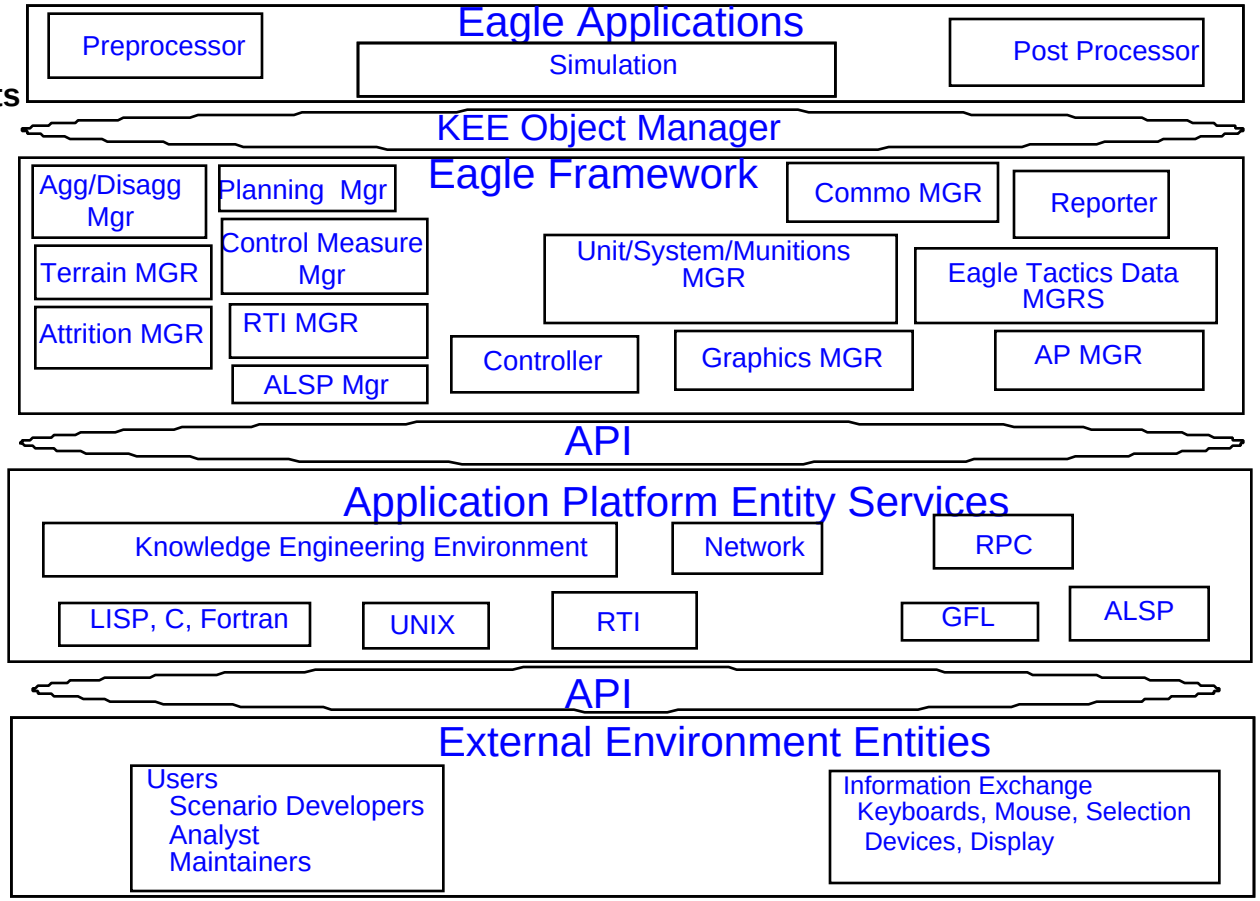
- 2 and 4 Eagle Federates.
- Fast as possible time management with reliable, time stamp ordering.
- Korean Scenario with a Blue Corps attacking a red army .
  - The blue forces have established a beach head north of Seoul with 1 Army Brigade and is attacking from the south with three brigades to effect a link up.
  - The red force is defending in the vicinity of Seoul with 2 regiments moving to reinforce from the North.
- 200 and 400 military units - Distributed with 50 Red and 50 Blue On Each Federate
  - The combat units are initialized with 43 attributes and on a 5 minute time step update up to 31 attributes.
  - The scenario without graphics running executes at a rate of 25 simulation hours of combat to 1 hour of real time.

Eagle Architecture

Applications are loaded individually or combined Simulation = Combat Units

Eagle Framework are services provided to applications. Responsible for maintaining ground truth.

Runs on HP and Sun workstations.



Current Interactions Allowed - Distributed Eagle

23 interaction types - total with subtypes: 65

Interaction	Initiating Class	Receiving Class
Engagement direct fire ground to ground	Attrition Manager	Attrition Manager
Bulk ammunition consumed	Attrition Manager	Ground-Movers, Air Movers
Engagement indirect fire ground to ground	Attrition Manager	Attrition Manager
Suppression update	Attrition Manager	Ground-Movers
Engagement Air to Ground	Attrition Manager	Ground-Movers
Aircraft abort flight notification.	Fixwing	Airspace manager
New air/ada events for Time Step.	Air Space Manager	Air Space Manager
Communications between units	Commo Manager	Commo Manager
Create control measure - db_consistency	Scenario Control Measures Manager	Scenario Control Measures Manager
Dead Target Updates - db_consistency	Attrition Manager	Terrain Manager
Register Eng. Work - db_consistency	Terrain Manager	Terrain Manager
Update Terrain Feature - db_consistency	Terrain Manager	Terrain Manager
Remove Terrain Feature - db_consistency	Terrain Manager	Terrain Manager
Ground receive losses air attack.	Attrition manager	Ground Movers
Activate IDF msn	Military Unit (Command)	Attrition Manager
Update tf occupcany - db_consistency	Terrain Manager	Terrain Manager
Update-active-aois	Ground-Mover	Air-Maneuver
Create-breach - db_consistency	Terrain Manager	Terrain Manager
Create-bypass - db_consistency	Terrain Manager	Terrain Manager
Set Unit visibility terrain- db_consistency	Military-units	Terrain Manager
Set Unit visibility map- db_consistency	Military-units	Terrain Manager
Set unit visible - db_consistency	Military-units	Military-units
Db-consistency, used to coordinate events	Aggregate actors	Aggregate actors
Eagle Management - stop, start ...	Eagle Controller, Confederation Manager	Eagle Controller, Confederation Manager
SIU - Dis interactions between actors	Model Network Manager	Model Network Manager
Resolution Unit Interface - C4I interactions	C4I Interface, Military Unit	C4I Interface, Military Unit
CommandUnit Interface - C4I interactions	C4I Interface, Military Unit	C4I Interface, Military Unit

Additional Challenges

1. Eagle can not have unique time management scheme for each Fed.
2. Eagle must maintain causality with DIS. Processing time must be considered in updates.
3. Eagle must be able to receive information from DIS in Eagle's Federate time past. (No real time functionality in RTI - yet)
4. Eagle must maintain consistency between its internal time step events which all occur at the same time.
5. Eagle must constraint time advance to RTI.

Tools provided by RTI that Eagle uses to maintain time & consistency:

- TIME_ADVANCE_REQUEST
- TIME_ADVANCE_GRANT
- NEXT_EVENT_REQUEST
- SET_LOOKAHEAD
- SEND_INTERACTION
- RECEIVE_INTERACTION
- SET_TIMESTAMP_RECEPTION
- SET_TIMESTAMP_GENERATION